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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/509,662	08/22/2005	Takuya Sugawara	101249.55470US	2368

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EXAMINER	
LEE, CHEUNG	

ART UNIT	PAPER NUMBER
2812	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/509,662	SUGAWARA ET AL.	
	Examiner	Art Unit	
	Cheung Lee	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 November 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *20-33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *20-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on *29 September 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Notice to Applicant

1. Applicants' Preliminary Amendment filed on November 21, 2007 has been entered and made of record.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 20-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kraft et al. (US Pat. 6136654; hereinafter "Kraft") in view of Murakawa et al. (JP2000-294550; hereinafter "Murakawa").

3. Referring to figures 1-7 and related text, Kraft discloses [Re claim 20] a process for treating a substrate 12 for forming an oxynitride film on a surface, comprising: providing the substrate having an oxide film 14 thereon; and irradiating plasma 16 on the oxide film (see fig. 2) using a nitrogen gas (col. 3, lines 58-65) to form the oxynitride film (18, 19, 20) (col. 4, lines 11-39), wherein a nitrogen atom content in the oxynitride film has a distribution such that the maximum value Ns of the nitrogen atom content in the oxynitride film at a surface of the oxynitride film opposite a surface facing the substrate is 10 to 40 atomic percent (col. 5, lines 28-45; see figs. 5-6), and the maximum value Nb of the nitrogen atom content in the oxynitride film at the surface facing the substrate side is 0 to 10 atomic percent (col. 5, lines 28-45; see figs. 5-6), but Kraft fails to disclose expressly wherein irradiating plasma having an electron temperature of 0.5 to 2.0 eV using a mixed gas comprising a rare gas and nitrogen gas.

Murakawa discloses wherein a nitriding process using an electron temperature of about 1 eV or less (paragraph 10), and using nitrogen gas with noble gases, such as argon (paragraph 19).

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a certain electron temperature with noble gas in a plasma nitridation, as taught by Murakawa, because it would have been to reduce a plasma damage using a certain electron temperature, and to control source gas flow rate and nitridation amount using a rare gas without any unwanted reaction.

4. Referring to figures 1-7 and related text, Kraft discloses [Re claim 25] a process for treating a substrate 12 for forming an oxynitride film on a surface, comprising:

providing the substrate having an oxide film 14 thereon; and irradiating plasma on the oxide film (see fig. 2) using a gas comprising nitrogen gas (col. 3, lines 58-65) to form the oxynitride film (18, 19, 20) (col. 4, lines 11-39), wherein a nitrogen atom content in the oxynitride film has a distribution such that a ratio Ns/Nb is 2 or more, wherein Ns is the maximum value of the nitrogen atom content in the oxynitride film at a surface opposite a surface facing the substrate, and Nb is the maximum value of the nitrogen atom content in the oxynitride film at the surface facing the substrate (col. 5, lines 28-45; see figs. 5-6). Figure 5 shows nitrogen distribution of 60Å oxide film, the maximum nitrogen atomic content at the top surface (oxide depth between about 0 to 10Å) is about 17 atomic percent and the maximum nitrogen atomic content at the interface between the oxide film and the substrate (oxide depth between about 50 to 60Å) is between about 0 to 1 atomic percent. Also, figure 6 shows the nitrogen intensity of about 7 at the top surface of the oxide film and the nitrogen intensity of about 1 at the interface between the oxide film and the substrate. Therefore, the ratio Ns/Nb is 2 or more. However, Kraft fails to disclose expressly wherein irradiating plasma using a mixed gas comprising a rare gas and nitrogen gas.

Murakawa discloses wherein a nitriding process using nitrogen gas with noble gases, such as argon (paragraph 19).

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use a noble gas in a plasma nitridation, as taught by Murakawa, because it would have been to control source gas flow rate and nitridation amount any unwanted reaction.

5. Referring to figures 1-7 and related text, Kraft discloses [Re claim 29] a process for forming a gate oxynitride film, comprising: providing a substrate 12 having an oxide film 14 thereon; and irradiating plasma 16 on the oxide film (see fig. 2) using a nitrogen gas (col. 3, lines 58-65) to form the oxynitride film (18, 19, 20) (col. 4, lines 11-39), but Kraft fails to disclose expressly wherein irradiating plasma having an electron temperature of 0.5 to 2.0 eV using a mixed gas comprising a rare gas and nitrogen gas.

Murakawa discloses wherein a nitriding process using an electron temperature of about 1 eV or less (paragraph 10), and using nitrogen gas with noble gases, such as argon (paragraph 19).

The motivation statement stated in claim 20 also applies.

6. Kraft discloses [Re claims 21, 26 and 33] wherein the plasma is irradiated at a temperature of 250 to 500°C and under a pressure of 3 to 260 Pa (col. 4, lines 1-11).

7. [Re claims 22, 27 and 31] Kraft fails to disclose expressly wherein the plasma is generated using microwave irradiation by using a plane antenna member having a plurality of slots.

Murakawa discloses wherein plasma is generated using microwave irradiation with a RLSA (radial line slot antenna) which has tow or more slits (paragraph 24).

At the time of the invention it would have been obvious to a person of ordinary skill in the art to use certain plasma equipment with microwave, as taught by Murakawa, because it would have been to obtain plasma with microwave radiation of a uniform intensity performing film-quality control.

8. Kraft discloses [Re claim 23] wherein the ratio Ns/Nb is 2 or more, and [Re claim 28] wherein the ratio Ns/Nb is 4 or more (col. 5, lines 28-45; see figs. 5-6). Figure 5 shows nitrogen distribution of 60Å oxide film, the maximum nitrogen atomic content at the top surface (oxide depth between about 0 to 10Å) is about 17 atomic percent and the maximum nitrogen atomic content at the interface between the oxide film and the substrate (oxide depth between about 50 to 60Å) is between about 0 to 1 atomic percent. Also, figure 6 shows the nitrogen intensity of about 7 at the top surface of the oxide film and the nitrogen intensity of about 1 at the interface between the oxide film and the substrate. Therefore, the claimed limitations are met.

9. Kraft discloses [Re claim 24] wherein the oxide film is formed by plasma processing or thermal oxidation (col. 3, lines 54-58).

10. Kraft discloses [Re claim 30] wherein the plasma is irradiated so that the nitrogen atom content in the gate oxynitride film has a distribution such that a ratio Ns/Nb is 2 or more, wherein Ns is the maximum value of the nitrogen atom content in the oxynitride film at a surface opposite a surface facing the substrate, and Nb is the maximum value of the nitrogen atom content in the oxynitride film at the surface facing the substrate (col. 5, lines 28-45; see figs. 5-6). Figure 5 shows nitrogen distribution of 60Å oxide film, the maximum nitrogen atomic content at the top surface (oxide depth between about 0 to 10Å) is about 17 atomic percent and the maximum nitrogen atomic content at the interface between the oxide film and the substrate (oxide depth between about 50 to 60Å) is between about 0 to 1 atomic percent. Also, figure 6 shows the nitrogen intensity of about 7 at the top surface of the oxide film and the nitrogen intensity of about 1 at the

interface between the oxide film and the substrate. Therefore, the ratio Ns/Nb is 2 or more.

11. Kraft discloses [Re claim 32] wherein the gate oxynitride film has a nitrogen atom content distribution such that the maximum value Ns of the nitrogen atom content in the gate oxynitride film at a surface opposite a surface facing the substrate is 10 to 40 atomic percent (col. 5, lines 28-45; see figs. 5-6), and the maximum value Nb of the nitrogen atom content in the gate oxynitride film at the surface facing the substrate is 0 to 10 atomic percent (col. 5, lines 28-45; see figs. 5-6).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cheung Lee whose telephone number is 571-272-5977. The examiner can normally be reached on Monday through Friday from 8:30AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571-272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Cheung Lee

January 14, 2008

MICHAEL LEBENTRITT
SUPERVISORY PATENT EXAMINER